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AMERICAN ANTS

The Honey Ants of the Garden of the Gods, and the Occident Ants of the American Plains. By Henry C. McCook, D.D. (Philadelphia: Lippincott and Co., 1882.)

LOOKING to the extensive and systematic work which Dr. McCook has already accomplished in the study of some of the most interesting species of New World ants, we are exceedingly glad to observe from this additional volume that he has now turned his serious attention to the honey ants, for, although the habits of this species were known to be certainly among the most remarkable of the many remarkable habits that are presented by the Hymenoptera, they have not hitherto engaged the study of any competent observer. As he himself observes, "Very little of their habits has heretofore been known, and only the forms of the honey-bearer and worker-major. In order, if possible, to remove this reproach from entomology, I started in the early part of July, A.D. 1879, for New Mexico."

In giving a short abstract of the results which have rewarded his energy, we may best begin by describing the forms or "castes" which Dr. McCook found to constitute a colony of honey ants. There are (1) three castes of workers, namely, major, minor, and minim or dwarf—the first being $8\frac{1}{2}$ mm. in length, the second 7 mm., and the third $5\frac{1}{2}$ mm. (2) Honey-bearers, "a sedentary class or caste distinguished by abdomens distended into a spherical form of expansion of the crop filled with grape sugar: the length (including abdomen) is 13 mm. (one-half inch); the proportions and description of the head and body are those of the worker-major, of which it may be a developed form." (3) Female, or queen—length 13 mm. (4) Male —length 5 mm.

Regarding the economy of the hive, the first important point established by Dr. McCook's observations is that the honey-bearers do not, as has been asserted, themselves elaborate the honey, but that this is gathered by the workers from a peculiar kind of vegetable gall, and by them poured into the crop or proventriculus of the honey-bearers; the honey-bearers are therefore nothing more than living store-houses for the food of the hive, their relation to the rest of the community being, as Dr. McCook observes, similar to that of the honey-comb cells to the hive bee. For not only do the worker-ants store the "rotunds," but when they require food they go to the rotunds, which feed them by pressing out a drop of their store from the œsophagus. Likewise "the queen, virgin females, males, and the teeming nursery of white grubs" are all dependent on the rotunds for nourishment. The honey is collected from the galls by the workers at night, the insects being very intolerant of sunlight, and quickly dying when exposed to it. The honey pressed from the body of the rotunds has a pleasant taste, somewhat resembling ordinary honey, but more aromatic, slightly acid, and contains a larger proportion of water—being, therefore, more limpid. It requires about 1000 honey-bearers to yield one pound weight (troy) of honey. Dr. Wetherill says, as the result of analysis, that the substance is "a nearly pure solution of grape-sugar which is in a state of hydration isomeric with grape-sugar, and differing from grape-sugar in not crystallising."

The working ants are so fond of the honey stored within the rotunds, that when, in making sections of the nests, Dr. McCook ruptured the abdomens of the rotunds, he always observed that, "notwithstanding the high state of excitement which pervaded the colony, the ordinary instinct to defend the nest and preserve the larvæ, cocoons, and other dependents, was at once suspended in the presence of the delicious temptation." It is therefore the more remarkable that when a rotund dies the workers do not open the abdomen to get at the contained honey, but, after severing the abdomen from the thorax, remove each part separately to a "cemetery," or common burying-ground which these ants, like many other species, maintain. The author suggests, and not improbably, that this forbearance on the part of the workers may be explained as "the result of an instinctive sentiment by which Nature guarantees protection to the living honey-bearer."

The partly-filled rotunds are not wholly dependent for their food upon the gorging process to which they are submitted by the workers, for when only partly filled, they will feed themselves on sugar; but the author never saw "a honey bearer of full rotundity taking food or drink." But the fact that before this insect is largely distended with honey it will feed itself points to the supposition that it may be itself a worker, slightly, if at all modified in structure; and this supposition is borne out by anatomical investigation. For the latter has shown: (1) "that it is the *crop alone* which contains the nectar received at the mouth"; (2) "that the organs of the abdominal portion of the alimentary canal are ordinarily in a natural state, except in so far as their position has been changed by the downward and backward pressure of the expanding crop"; and (3) "that the process by which the rotundity of the honey-bearers has probably been produced has its exact counterpart in the ordinary distension of the crop in over-fed ants; that at least the condition of the alimentary canal in all the castes is the same, differing only in degree, and therefore the probability is very great that *the honey-bearer is simply a worker with an overgrown abdomen*." "Why the extraordinarily distended crop seen in the honey-ant should be limited to two species (so far as known), and why so limited a number of workers in the formicaries of these two species should develop the round abdomen, are questions that provide sufficient wonder, but yield scant satisfaction."

The degree of distension which the crop of a fully-gorged rotund undergoes is certainly most surprising. Among the thirteen plates with which Dr. McCook's work is illustrated, several figures are given of the crop in various stages of repletion. In the comparative scale of representation adopted, the empty crop is drawn about the size of a pea, and the fully distended one about that of a tennis ball.

Regarding less special points of interest, we may notice the "absence of individual beneficence." Not a single instance of such beneficence was noticed, although closely watched for, while the exhibitions of an apparently cruel neglect were many. Thus, "the grains of sand and soil were heaped around the rotunds, until the poor creatures were literally buried alive. It would have been easy for the busy masons to draw their fellows aside and thus carry on their work. But it either never occurred to them to do so, or the disposition was wanting." This, however, applies to the case when the ants are engaged in making a new nest after having been transferred *en masse* by the author to hitherto unbroken ground. But "in the natural sites the workers showed great interest in the preservation of the rotunds, dealing with them very much as with the larvæ." In these natural sites the rotunds hang suspended by their claws, backs downwards, from the roof of their underground chamber, and if they fall to the floor they are unable to move from the spot on account of their unwieldy mass. In such a case several workers "would join in removing one rotund pushing and pulling her along. . . . Another sketch represents a worker-major dragging a rotund honey-bearer up the perpendicular face of a cutting made in the excavation of the nest. The mandibles of the two insects were interlocked, and the worker *backed* up the steep, successfully drawing her *protégé*." It seems, however, to have been undetermined whether in such a case the worker restores the rotund to her place on the roof of the chamber; it is certain that they did not do so in the author's artificial formicaries, for although the fallen rotunds "were faithfully attended, often cleansed and caressed, in no single instance did the workers attempt to right them and restore them to the roof."

It will be seen from this brief epitome of Dr. McCook's results that, while adding a number of new facts, they partly confirm, and partly contradict the previously published statements of Llane (1832) and Wesmael (1838). But, as Dr. McCook himself observes, "One of the most perplexing accounts of the honey ant is that of Mr. Henry Edwards," who recorded the statements from a verbal description given to him by Capt. W. B. Fleeson, whose observations were made at or near Santa Fè. This description was first published in the *Proceedings* of the California Academy of Sciences (vol. v. p. 72, 1873), and afterwards in the columns of this journal. Its chief points were that the honey-bearing ants are suspended to the roof of this chamber by meshes of web, that there are three very distinct castes, if not species and genera of ants forming a colony, that the larger kind form a fortress of a most remarkable character, and also gather leaves and flowers which they deposit in the middle of their fortress, leaving them to be then conveyed by ants of a second species to the honey-bearers as food. The remarkable fortress was described as being formed in the shape of a perfect square, having one side open and always facing due south, while round the remaining three sides the ants of the larger species were described as perpetually parading in a double line of defence. None of these assertions have been corroborated by Dr. McCook, and therefore he may be excused for suggesting that Capt. Fleeson may perhaps have been "testing the credulity of the writer by one of those jokes of which naturalists are occasionally the victims." "But," he adds, "if the narrative is to be taken in good faith, I can only explain the facts by supposing that the observer happened upon a nest of cutting ants (*Atta fervens*) within whose boundaries a nest of Melliger had chanced to be established, and had confounded the habits of the two as those of one formicary; or, second, that the cutting ants, or some other species of a similar economy, has really acquired the habit of kidnapping and domesticating the honey-ant for the sake of its treasured sweets, precisely as many ants domesticate aphides." "The porterage of leaves, &c., into nests is not an uncommon habit among ants of divers species; therefore, without stopping to discuss the question whether such material may contribute to the food supply of the formicary, it may be remarked that its most probable and ordinary use is for purposes of architecture or nest-building."

After again reading the account as published by Mr. Edwards, we cannot entertain the suggestion that he has been the victim of an intentional hoax. But as the suggestion has been made by an honest and independent observer, we feel it to be incumbent on those who were responsible for the publication of the account to repudiate the insinuation of dishonesty; and, looking to the definite nature of the statements which that account contained, we feel it is now more desirable than ever that they should be either verified or disproved by some competent naturalist visiting the locality where the observations are said to have been made.

The second part of Dr. McCook's volume treats of the Occident Ants of the American Plains. These build mounds from less than half a foot to more than a foot in height, round which they make a circular "clearing" of grass and other vegetation, presumably by cutting it away after the manner of the agricultural ants of Texas, previously described by the same author. The mound is always covered with pebbles which have been removed in the process of excavating the underground chambers and galleries. Some of the pebbles so transported are ten times the weight of the ant, so that the labour performed would be paralleled by that of a man if he could carry half a ton up a staircase one-third of a mile high.

These ants do not begin their labour till eight or nine o'clock in the morning; so, as Dr. McCook seems not unwilling to observe, "it might not be unmeet that those persons whose love of sleep during late morning hours has been disturbed by the familiar Scripture proverb, 'Go to the ant, thou sluggard; consider her ways, and be wise!' should return upon their mentors with the above-recorded facts, and cite this ant, who is indeed no sluggard, as being nevertheless fond of a morning nap." The day's work, or at any rate the day of out-door work, begins by opening the gates which had been closed the previous evening. "The manner of opening the gate cannot be fully described, because the work is chiefly done within and behind the outer door of gravel. The mode would doubtless be correctly indicated by reversing the process of closing gates, presently described. What I saw was, first, the appearance of the quivering pair of antennæ above one of the pebbles, followed quickly by the brown head and feet projected through the interstices or joints of the contingent gravel-stones. Then forth issues a single worker, who peeps to this side and that, and after compassing a little circuit round about the gate, or perhaps without further ceremony, seizes a pebble, bears it off, deposits it a few inches from the gate, and returns to repeat the task; she is followed, sometimes cautiously and at intervals of ten, twenty, even thirty minutes, by a few other ants, who aid in clearing away the barricade, after which the general exit occurs. Again there is a rush of workers almost immediately after the first break, who usually spread over the hill, bustling around the gate, gradually widening the circles, and finally push out into the surrounding herbage. At first the exit hole is the size of a pea, perfectly round, and plainly shows that sand and soil have been used under the gravel to seal up the gate. The whole appeared to have been cemented, probably by the moisture of the night dew.

"The process of closing the gates is even more interesting to the observer than the opening, as the various steps are more under his notice. . . . At nest A the closing was chiefly from within. The workers pushed the sand from the inside outwards with their heads. A grass straw about an inch long was brought from the interior and pushed out until it lay across the gate as a stay for the filling material. Soil was here principally used for closing, a few pebbles being added." In another case, "when the gate was nearly closed a straggling minor came back from the commons and essayed entrance, wherein she failed. Several trials and failures succeeded, whereupon she commenced dragging the dirt from the opening. While thus engaged the major approached with a huge bit of gravel, which she deposited on her comrade with as much nonchalance as though she were one of the adjoining pebbles. At last the minor dug out a tiny hole through which she squeezed into the nest, and the major, who was deliberately approaching close behind her, carrying another pebble, immediately sealed up the opening. During this amusing episode the straggler made no effort to aid in the closing, being wholly intent on entering, and the gate-closer paid no attention to her whatever, beyond the first sudden and satisfactory antennal challenge. Each moved forward to her own duty with the undisturbed plasticity of a machine."

This "by-play" between the gate-closers and the late-returning foragers is not the exception but the rule; nevertheless it does not appear that the foragers ever so far miscalculate their time as to arrive after the gates are completely closed. When the gates are all but closed there is generally but a single ant engaged in the closing process from without; this ant slips in at the last moment, and the process is finally concluded from within. The gates are similarly shut during the day-time if the weather seems to threaten a heavy rain-storm.

In disposition the Occident Ants, though provided with very formidable stings, are exceedingly mild and unwarlike—so much so, indeed, that even when greatly incommoded by the tiny but viscous erratic ants which Dr. McCook observed on one occasion to have impertinently established a nest within their "clearing," they would not dislodge or even fight their insignificant foes, but "entirely abandoned their old avenue, cut down and around the erratic colony, and made an opening on the edge of a slight ridge several inches beyond the disputed territory, but still in the line of the avenue which they had been using in their work. A tithe of the pains required for this task would have literally cut out and carried away the whole nest space of the erratics, whose scant numbers of diminutive warriors could have been overwhelmed in a moment by the legions of their huge hosts."

Lastly, Dr. McCook has satisfactorily ascertained that these Occident Ants present the same habits of "harvesting" as those which were previously known to occur in the allied species of Florida and Texas. His work as a whole deserves warm commendation, and we trust that the success which has attended his study of the sundry species of ants that have hitherto engaged his attention, will induce him to extend his researches to those other species on the American continent which present habits and instincts, if possible, more remarkable than those which he has done so much to elucidate.

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OUR BOOK SHELF

The Story of our Museum, showing how we Formed it, and what it Taught us. By the Rev. Henry Housman, A.K.C., &c., &c. (London: Society for Promoting Christian Knowledge, 1881.)

THIS is a most excellent book for a boy with a taste for natural history. It describes in a pleasing and natural way how two boys living in a country village in Gloucestershire began to make a museum. It narrates all their difficulties, their failures, and their successes; and how, by perseverance, and with very little expense, they gradually formed a collection illustrating the whole range of the natural history and antiquities of their district, including, besides, postage-stamps and autographs. How much pleasure and how much knowledge are to be obtained while forming such a collection is very well shown; and though there is little novelty in the book, occasional diffuseness in the treatment, and hardly any passages that will bear separate quotation, these trifling deficiencies do not at all detract from its merit as a book for boys, which is all that it pretends to be.

The one decided innovation on the almost universal practice of collectors is, the strong recommendation of a natural system of mounting butterflies and moths. The usual mode of exhibiting the lepidoptera, all set out with expanded wings on one horizontal plane, is objected to as being monotonous and completely false to nature. Of course in an extensive systematic collection this method is absolutely necessary, for classification, easy reference, comparison, and critical examination; but in forming a purely local collection, the superior advantage of the natural system of mounting are strongly advocated, at least for the butterflies and all the larger moths. These should be exhibited sitting or flying, with the wings elevated or depressed, as if alive, and the legs and antennæ placed in natural positions. Of course this requires glass cases for these insects as for birds; but when the collection is restricted this is no objection; and by exhibiting the preserved larvæ, eggs, and pupæ, along with the perfect insects in all their different natural attitudes, it is maintained that much more instruction will be afforded, while the effect will be far more picturesque and pleasing than the straight rows of unnaturally expanded insects can ever be.

The only other part of this volume calling for further notice here, is an appendix, "On the Arrangement of Natural History Collections," in which the more natural and attractive arrangement of the galleries of public museums is strongly advocated. As regards the higher animals, there is nothing fresh in these recommendations; but the author also urges the exhibition of complete series of such fossil species as illustrate the persistence of types or the development of forms throughout considerable geological periods. This, however, is never done in our great public museums. In the case of living animals the species are exhibited in systematic groups, while no attempt is made to show the equally interesting geographical grouping; while with extinct animals an opposite